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Indian Standard

SELECTION, INSTALLATION, OPERATION AND MAINTENANCE OF SUBMERSIBLE PUMPSET — CODE OF PRACTICE

ICS 23.080

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

April 1998

Price Group 2

Pumps Sectional Committee, HMD 20

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Pumps Sectional Committee had been approved by the Heavy Mechanical Engineering Division Council.

A large number of borewell submersible pumpsets covered in IS 8034 are in use for supply of clear cold water. It was decided to formulate an Indian Standard to provide guidelines on selection, installation operation and maintenance of submersible pumpsets which would be useful for the consumers to ensure trouble free operation of the pumpsets. Hence this Indian Standard has been formulated with this objective.

Indian Standard

SELECTION, INSTALLATION, OPERATION AND MAINTENANCE OF SUBMERSIBLE PUMPSET — CODE OF PRACTICE

1 SCOPE

This standard lays down general guidelines for selection, installation, operation and maintenance of borewell submersible pumpsets covered in IS 8034.

2 REFERENCES

The Indian Standards listed below are necessary adjuncts to this standard:

IS No.	*Title*
694 : 1990	PVC insulated cables for working voltages up to and including 1 100 V (*third revision*)
1239 (Part 1) : 1990	Mild steel tubes, tubulars and other wrought steel fittings: Part 1 Mild steel tubes (*fifth revision*)
4984 : 1995	High density polyethylene pipes for potable water supplies (*fourth revision*)
4985 : 1988	Specification for unplasticised PVC pipes for potable water supplies (*second revision*)
8034 : 1989	Specification for submersible pumpsets (*first revision*)
9283 : 1995	Motors for submersible pumpsets (*first revision*)
10804 : 1994	Recommended pumping system for agricultural purposes (*second revision*)
12231 : 1987	UPVC (rigid) pipes for use in suction and delivery lines of agricultural pumps

3 SELECTION CRITERIA FOR PUMPSET

The selection criteria are:

a) Bore well size, yield and depth;

b) Performance requirement namely pump flow rate and total head;

c) Type of power supply; and

d) Nominal speed.

4 BOREWELL SIZE

Major use of submersible pumpsets is by way of installation on bore wells and hence, the diameter of the borewell determines the barrel size of pumpset according to its suitability with the borewell size.

Type of borewell like deepwell/shallow well and position of strainer pipe are to be mentioned by the purchaser, so that pumpset is not lowered against strainer pipe. Accordingly the lowering depth is decided.

For safe erection and removal of the submersible pumpsets and subsequently to maintain suitable suction flow velocity in remaining ring section between the unit and tubewell casing, maximum outside diameter of the pumpsets with respect to tubewell diameters are recommended as given in Table 1.

Table 1 Maximum Outside Diameter of Submersible Pumpset

Nominal Diameter of the Tubewell mm (1)	Maximum Outside Diameter of Submersible Pumpsets mm (2)	Corresponding Minimum Diameter of Checking Mandrel mm (3)
100	98	102
115	108	112
150	146	150
200	196	200
250	245	250
300	296	301

NOTES

1 The size and straightness of the bore well should be checked by a mandrel with minimum dia given in col 3 of Table 1 and of length minimum equal to the length of the pumpset.

2 The drill bit size used for drilling the borehole should be such that the checking mandrel is lowered up to the end of borehole and taken out of it easily.

5 DISCHARGE

The yield of the borewell shall be tested by the drilling contractors and a report is furnished by them regarding the continuous availability of water and its level when a certain quantity of water is being pumped out from the borewell. To ensure longer life and optimum efficiency of the borewell, it is recommended that the rated discharge of the pump should be taken as approximately 85 percent of the yield of the borewell. Thus, the discharge of the pump is decided. From various types of pumps available in the manufacturing range, a suitable type of pump is selected, based on borewell size and required discharge, which gives maximum efficiency at that particular point.

6 TOTAL HEAD

The total head shall be worked out by considering the following aspects:

a) Level of water below the ground level when the rated/desired discharge is being pumped out.

b) Variation of water level taking place in season.

c) Delivery head above ground level that is vertical height of the top most delivery point of water from the ground level.

d) Frictional losses taking place in bend, nonreturn valve, reducers, gate valve, column pipe and delivery pipe depending upon size and length and type of pipe.

Addition of all above gives the total head at which the desired pumpset will be working.

7 STAGE AND RATING OF PUMPSET

For the desired head and with selected type of pump, number of stages required is known for the type of pump. The number of stages give the corresponding rating of motor by referring to the performance chart/ characteristic curves given by manufacturer.

8 CABLE SELECTION

It is recommended that the cable size is selected from the cable selection chart provided by the pumpset manufacturer, based on motor current and the length of the cable required. If the chart is not provided by the pumpset manufacturer it is recommended that the maximum voltage drop for the motor current should not exceed 3 percent of the supply voltage from the control panel to the motor terminal. If, due to longer length of cable for a particular current, the point is at the end of boundary of selection chart for that size of cable, then next higher size of cable shall be selected. This will enable the motor to work satisfactorily as the voltage drop between supply point and motor terminals will be minimal and overheating of winding will be reduced thereby increasing the life of motor.

NOTE — For star delta starting, the current to be taken for cable size selection is to be phase current which is 0.58 x line current.

9 SELECTION OF PIPE SIZE

Normally the minimum size of delivery pipe shall be at least equivalent to the pumpset nominal outlet size. But to reduce frictional losses in the pipe, higher diameter of pipes may be used as provided in IS 10804. Accordingly other supporting clamps and cable clips shall also be specified depending upon the diameter of the pipe selected.

10 PROTECTION DEVICES

10.1 Protective Devices for Motor

The protection devices are required to take care of:

a) Starting and stopping,

b) Overload,

c) Under and over voltage,

d) Single phasing in case of 3 phase pumpsets,

e) Dry running,

f) Short circuit/lightening protection, and

g) Proper indicating instruments.

All the above accessories shall be mounted on a control panel.

10.2 Earthing

Earthing should be provided as per **5.4** of IS 9283.

10.3 Protective Devices for Pump and Pipes

a) Control valve is recommended at the delivery line and ground level.

b) Suitable devices like check valve, air valves, surge tank, etc, shall be provided in the delivery to avoid water hammering.

11 INSTALLATION

A hoist or a winch of sufficient capacity is required for lowering and installing the pumpset in borewell. Suitable tools like pipe wrench and spanners, etc, shall be available at the site for easy and quick installation. The procedure for installation of a submersible pump in bore well is as follows:

a) Open the motor and pump packing cases, check for any transit damage before erection.

b) Keep the motor in vertical position.

c) Wherever liquid filling is required, filling of the motor with the liquid shall be carried out as per the instructions of the manufacturer.

d) Check for free rotation of motor shaft manually.

e) Check the insulation resistance of the motor by 500 V DC megger and also check the direction of rotation by giving supply to the motor for few seconds.

f) Couple the pump to the motor. After coupling, check with the help of a suitable tool at the coupling whether the pump rotating assembly gets lifted or not. If it gets lifted then the coupling is correct.

g) Note down pump and motor nameplate data for future reference.

h) Join required length of cable if necessary. For cable jointing, follow the manufacturer's recommendation.

j) Lower the unit without jerk with pipes by means of hoist/winch and supporting clamps along with earthing and anchorage (wherever applicable) and continue connecting subsequent lengths of pipe.

k) While lowering the unit without jerk, keep on fixing the cable clips at every three meters length of pipe to keep the cable in position.

NOTE — Care is to be taken for prevention of any cable damage during lowering of the unit.

m) Ensure that pump has been lowered along with the submersible cable to the required depth.
n) Fit the supporting clamps.
p) Check for insulation resistance of the motor once again with a 500 V DC meggar.
q) Now connect the cable to the control panel.

12 OPERATION

a) Switch on the supply and check for the incoming voltage which should be the rated voltage.

b) In case of 3 phase submersible pumpset, check whether all three phase supply voltage is balanced or not. If not, do not start the pump.

c) Ensure proper earthing is done at the ground level.

d) If above parameters are checked and found all right, then the pump is ready to start.

e) Start the pump and check for the discharge. Rated discharge will show the correct direction of rotation.

f) Throttle the delivery valve up to approximately 1/3 of rated discharge. Do not stop the pump till clear water starts coming out. Open the delivery valve fully after clear water is obtained.

13 MAINTENANCE AND TROUBLE SHOOTING

To ensure proper operation of the pumpset, the ground level protection devices should be periodically checked. The common troubles and probable reasons are given in **13.1** to **13.7**.

13.1 Less Discharge

a) Operational system head is more than rated pump head.

b) Yield of borewell not adequate.

c) Lower speed of motor due to low voltage/low frequency/excessive friction.

d) Choking of strainer/impeller/pipes.

e) Delivery valve/NRV/Check valve not fully opened.

f) Improper direction of rotation due to change in phase sequence of power supply.

g) Leakage in delivery pipe.

h) Excessive abrasive wear out of pump components.

13.2 Pump Draws Excessive Power/Current

a) Misalignment of pump and motor.

b) Higher speed of motor due to higher supply frequency/excessive supply voltage.

c) Duty point of the system not matching.

d) Rubbing of rotating parts with stationery parts.

e) Bearings worn out.

f) One defective fuse, single phasing.

g) Change in the actual static head.

h) Low voltage.

j) Cable in defective condition.

k) Loose connection of input supply.

13.3 Excessive Vibration

a) Improper alignment.

b) Inadequate water level.

c) Bearings worn out.

d) Shaft bent.

e) Abrasive wear of pump bearings after prolonged operation or due to operation in water of higher sand content or corrosiveness.

f) Foreign bodies lodged in impellers.

g) Pump resting improperly on borewell bed.

h) Air or gas inclusion in water.

j) Dry running of pump.

k) Reverse rotation.

13.4 Zero Discharge

a) Failure of power supply.

b) Operating head is beyond the range of pumpset.

c) Pump not properly submerged in water.

d) Strainer/impeller/delivery valve/check valve/NRV/pipe fully choked.

e) Coupling broken.

13.5 Pump Seizure

a) Improper alignment.

b) Dry running of pump.

c) Bend in shaft.

d) Pump remains unused for prolonged period.

e) Clogging of foreign matter.

f) Bearing worn out.

13.6 Wearing Out of Parts

a) Misalignment

b) Presence of sand particles.
c) Improper selection of material.
d) Frequent dry running.
e) Quality of water.

13.7 Pump Does not Start

a) Tripping of overload relay.
b) Low supply voltage.
c) Pump seized.
d) No power supply.
e) Blown fuse.
f) Failure of protection devices.
g) Failure of cables/cable joints.

NOTE — To ensure correct operation it is necessary to have correct information given by various measuring instruments installed on control panel. Periodical checking and calibration of the measuring instruments are necessary for proper and correct feedback.

14 CABLE JOINTING

The cable jointing is a critical parameter for performance, safety and service life of the pump. The cable jointing shall be done strictly as per pump manufacturer's instructions and the insulation resistance and the strength of the joint is thoroughly checked.

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